coupled with that of Van Benedin and numerous other European zoölogists, we assume is weight enough to give respectability.

The luminosity of gorgonias, sea-worms, star-fishes, etc., is a well-known fact to us from long residence on the Florida reefs; but, should it be desirable to fortify such evidence, we would refer to testimony of Sir Wyville Thompson, and several other successful dredgers.

It would have saved somewhat of the task of this *exposé*, had the reviewer read the history of the *Brisinga*, the luminous star-fish, which 'Living Lights' gives amply, and illustrates by process picture from the original, through courtesy of M. Filhol and M. Dubois, the latter having had some of the dredgings of the 'Talisman' for examination. The work of Charles Abjordsen of Norway, on the luminosity of this creature, is also extant, who pleasantly named it *Gloria maris*. M. Quatrefages may also be called to testify, if need be, whose valuable work on the luminosity of the star-fishes is well known. P. Martin Duncan and some others are remembered in this connection.

The crustaceans are next summoned to show cause. Must we arraign our own Verrill and Smith? Shall the ancient Viviani be questioned? May we lightly dispute the words of Nordenskiöld, Giglioli, Sir Joseph Banks, MM. Eydoux and Souleyet, Norman, Vaughn, Thompson, Murray, V. Willemoes Suhm, and a host of others whose descriptions of the luminosity of crustaceans are not in sober earnest to be called "displays of pyrotechnical natural history"? The attractive picture of *Colossendeis*, copied from M. Filhol's delightful work, is one with others which the reviewer chooses to designate as "conjectural illustrations" and "ideal view for which there is no excuse."

Regarding fishes, Dr. Gunther's views and statements are considered good science. His kindly correspondence with the author pleasantly confirms all that he has written on phosphorescence of fishes.

M. Carlo Emery, of the Italian Zoölogical Schools, kindly communicated his experiments to the author, with drawings, on the luminosity of the insect *Lucciola italica*. It were better due this eminent naturalist in the pages of an American science journal to acknowledge his original investigations in the spirit of science, rather than pronounce them examples of "pyrotechnical natural history," etc.

It certainly cannot be necessary to go further; but as the picture of a heron was particularly mentioned as "distinctly misleading," etc., it may be well to direct attention to the facts in the case. Attention to the text will show that the author carefully and at much trouble set about gaining, if possible, any additional knowledge concerning the alleged luminosity of the breast of the night-heron. It has long been a widely known belief among hunters that the powder-down patches on the heron's breast are at times luminous. We have learned from very many ornithologists that the belief was familiar to themselves, and in general there is an inclination to consider it true. The editor of 'Living Lights' received some remarkable confirmations of the long-existing say-so, and in his book plainly exhibits several of the most convincing, — no less than positive statements in answer to categorical inquiries by the author.

It chanced that we were able to ask the opinion of the eminent English naturalist, Mr. Alfred Russell Wallace, to whom this subject was familiar. He expressed readiness to believe the existence of luminosity in such birds, notwithstanding the literature on the subject is so meagre, and quoted the well-known case of the lantern-fly. Mr. Wallace was an explorer in South America, as is well known, and in answer to our question he said, "I did not observe the phenomenon of luminosity in the lantern-fly, but Madam Mérian, the distinguished entomologist, and the Marquis Spinola, did; the former giving detailed accounts of several which emitted such powerful luminosity, on opening the box in which they were confined, that she was alarmed. I am therefore not entitled to deny the statements."

Regarding the higher animals and man, as in relation to the phenomenon of luminosity, the long-recorded example of the brilliant eyes of the South American monkey should be regarded; and if the statements concerning man, as published by Dr. Phipson in his nearly unique treatise on this subject, as quoted by the author, are not entitled to respect, and protection from the assertion that such "statements are distinctly misleading and wrong . . . and highly colored, and admitted on very slender evidence," then we have no remedy.

In a few words, the considerable fresh material in 'Living Lights' should have received favorable notice; for, added to the large amount of facts in marine zoölogy long familiar to the author through actual personal contact with marine life on all parts of our coast, on the extreme northern and on the Florida shores, and on the two oceans, here is presented noticeable examples of luminosity in every grand division of zoölogy, and in the vegetable and mineral worlds, all furnished by the eminent zoölogists, with accompanying figures, which the reviewer has chosen to ignore or ridicule.

The amount of information and data obtained by the author through the United States Fishery Commission is very great, and it is due to the memory of the late lamented commissioner to say that the work of the 'Albatross' and 'Fish Hawk' exceeds all others in the contributions to science derived from the deep-sea dredgings. The history of luminous marine animals, judged by those acquainted with marine zoölogy, is by no means exhausted.

A.

New York, Oct. 26.

Sorghum-Sugar.

IN an article under the above caption published in *Science* about a year ago (viii. p. 361), I ventured to make the following prediction with reference to the experiments which were being carried on in Kansas under the direction of the United States Department of Agriculture: —

"The indications from the present results are most hopeful, — that, with the expenditure of a small fraction of the money and brains that have been required to develop the sugar of the beet, the sorghum-sugar industry will take a leading place among American industries, and enable Uncle Sam to accomplish a long-cherished hope, viz., of making his own sweets."

The results of this season's work, while it is not yet fully completed, would seem to show that this prediction is in a fair way to be fully confirmed within a very few years, for a great advance has already been made towards the solution of the problem of the profitable production of sugar from sorghum.

The final outcome of last year's work was extremely discouraging to many friends of the industry, and it was only by strenuous efforts on the part of the few who still retained their faith, that the necessary appropriation for the continuation of the experiments could be obtained from Congress. Many thought that the question would be definitely settled by the experiments last year, and, as the results achieved were chiefly of a negative character, they considered that it was proved a failure. Perhaps too much was expected to be accomplished in so short a time. It has often been the case with great undertakings, and in the accomplishment of scientific problems, that their prospect looked darkest just before the dawn of their success. Such has been the case with sorghum-sugar. Negative results frequently contribute greatly toward ultimate success, and the lessons taught by some of last year's failures have been turned to very valuable account in this year's work.

The two difficulties mentioned in the article referred to as encountered in last season's work — viz., the cleaning of the chips, and the treatment of the juice — have been successfully grappled with. The former is accomplished by ingenious yet simple mechanical devices. The cane is fed, leaves and all, to an ordinary ensilage-cutter, which cuts it all into pieces about one and a half or two inches in length. These are carried to a height by an elevator, and thence dropped through a series of separating-fans, where the refuse, consisting of the blades and sheaths, is blown out; its separation from the sections of cane being quite complete on account of the much greater weight of the latter. The cleaned pieces of cane are then carried to a small cylindrical cutter, whose operation is very similar to that of a planing-machine, and which cuts the cane into quite small chips, or shreds. Thus the diffusion is effected upon well-cleaned cane, — a fact which doubtless contributes greatly to the purity of the juices obtained. The inversion of the juice in the cell, which is very apt to occur with sorghum on account of its large content of various vegetable acids, is controlled by the use of precipitated carbonate of lime, which is added to the contents of

each cell. By this a considerable proportion of these acids is neutralized. In the treatment of the juice the solution of the problem seems to have rested rather in the simplification of the method to be used than in its further complication. In fact, it is really a return to first principles, as it were; for the method which was finally adopted, and which has given such excellent results, is the old method of liming the juice to a slightly alkaline re-action, and boiling and skimming in an open pan. No filtration is used whatever, the scums being simply returned to the cells, where they are again extracted, so that no loss of sugar is sustained. Treated in this way, the diffusion juice shows a higher coefficient of purity than juice obtained from the same cane by pressure, also an increased ratio of sucrose to glucose.

Single experimental runs have given a yield as high as one hundred and thirteen pounds of 'first sugar' to the ton of cleaned cane, with seventeen and a half pounds of 'second sugar,' or a total of one hundred and thirty pounds to the ton. This is at least twice as large a yield as has ever been obtained by pressure extraction, even under the most favorable conditions. The results on the season's work have not yet been ascertained.

The people of Kansas are highly pleased over the results of the work so far, and, with characteristic Western energy, are preparing to rush into the sugar-business immediately, and make Kansas, in the language of the local newspapers, 'rival Louisiana' as a sugar-producing State. A few words of caution to these would-be sugar-growers might not come amiss. No industry requires more careful management, or a greater amount of scientific knowledge and skill, to make it a success, than the production of sugar. In order to compete with other sugar-producing countries and plants, the most careful system of cultivation should be combined with the most skilful and economical methods of manufacture. The beet-sugar industry of Europe may well serve as a model in this respect, in that the proper cultivation of the beet-roots is regarded as of prime importance, and in the manufacture of the sugar every pound of waste or by-product is utilized, and every ton of fuel is made to yield its maximum equivalent of power. The most careful and thorough scientific supervision is exercised over the entire process of manufacture. At the present prices for sorghum-seed, which is in great demand for planting for forage purposes and for the sirup, a yield of any thing in the neighborhood of one hundred pounds of sugar to the ton of cane would afford a very wide margin on the cost of production, since the cane can be grown for one dollar and fifty cents per ton; but the success of the industry would necessarily involve the reduction of the prices for these important by-products to a much lower figure, and cut off a very considerable proportion of the present profits in the production. On the other hand, much is to be hoped from the apparently great adaptability of the plant to the soil and climate of a large area of this country, and from scientifically conducted experiments for the increase of its saccharine content. Judging from analogy, it is reasonable to expect that the latter can be greatly increased by the well-known methods of selection and cultivation. Sorghum-cane has been grown on the grounds of the Department of Agriculture at Washington, which contained as high as eighteen per cent of sucrose in the juice, or sixteen per cent of the cane. If a field of sorghum could be raised which would average fifteen per cent of sucrose without too great an expenditure for cultivation, the question of the profitable production of sugar from the plant would be solved at once.

This much, at least, can be said of the experiments that have been carried on by the Department of Agriculture: they have shown that good marketable sugar can be made from sorghum-cane in sufficient quantities to pay at the present prices for the products and by-products of the manufacture. The question as to whether we are to have a national sugar-industry in the United States will probably work out its own solution before many years.

These experiments in the manufacture of sugar should have a particular interest for scientific men, for their success means not only a triumph of science, but also a complete vindication of the policy of giving governmental aid to scientific investigations. The development of the sorghum-sugar industry so far has been carried on entirely by the Department of Agriculture, with appropriations made by Congress for that purpose. Numerous objections have been raised against these appropriations, and both loud and deep have been the repinings as the years went on and no practical outcome was obtained. In case they are crowned with ultimate success, these objectors will be most fitly answered; for the money spent would be but as a molecule of water to the Mississippi River in comparison with the stream of wealth which would flow from the establishment of a national sugar-industry. Let us hope the lesson will have its effect upon the people in the adoption of a still more liberal policy in aiding scientific research in the future. The experiments in the application of the diffusion to Louisiana cane will be commenced some time in October. From the favorable results which were obtained last fall at Fort Scott in operating upon a few carloads of cane after the close of the sorghum season, it may reasonably be expected that the yield obtained will be very satisfactory, although the problem is somewhat more difficult than in the case of sorghum, as the results obtained by mill-extraction from the Southern cane are much superior to those obtained from sorghum.

C. A. CRAMPTON.

Fort Scott, Kan., Oct. 23.

The Purslane-Worm.

IT may be of interest to note that the 'purslane-caterpillar,' described in a recent number of *Science* (x. No. 246), has made its appearance at this point; at least, a new species of caterpillar, new to all observers, and feeding on purslane, has made itself very conspicuous for a few months past. In this vicinity the early summer was very dry, and the purslane, which is not yet so common a weed with us as farther east, was not very plentiful. But late in August, after a series of heavy showers, it sprang up, *more suo*, abundantly, and with it came this stranger in such numbers as to attract the notice of one quite unlearned in such matters. Both the plant and its boarder flourished along the line of a railroad leading south-east into Kansas, from which State it is in all probability an emigrant; but, if so, one would think that it must have advanced farther last season than your Kansas correspondent noted.

GEO. M. WHICHER.

Hastings, Neb., Oct. 25.

Queries.

16. PENNSYLVANIA POT-HOLES. — Can you tell me where I can find an account of the glacial pot-hole noticed in your 'Notes' in No. 246? I presume it may be in some volume of the Second Geological Survey of Pennsylvania, but I do not know which one. Perhaps some of your readers can say, if you cannot.

JOSEPH F. JAMES.

Oxford, O., Oct. 23.

17. DOES BITUMINOUS COAL CONTAIN ANY BITUMEN? — Many text-books and dictionaries define bituminous coal as containing bitumen, and mislead the student into the belief that its name is due to this fact. In Vol. VI., 'Encyclopædia Britannica,' ninth edition, Mr. H. Baurerman, F.G.S., Royal School of Mines, says on p. 46, under the subject coal, "The most important class of coals is that generally known as bituminous, from their property of softening, or undergoing an apparent fusion, when heated to a temperature far below that at which actual combustion takes place. This term is founded on a misapprehension of the nature of the occurrence, since, although the softening takes place at a low temperature, still it marks the point at which destructive distillation commences, and hydrocarbons both of solid and gaseous character are formed. *That nothing analogous to bitumen exists in coals, is proved by the fact that the ordinary solvents for bituminous substances, such as bisulphide of carbon, and benzole, have no effect upon them, as would be the case if they contained bitumen soluble in these re-agents.* The term is, however, a convenient one, and one whose use is almost a necessity from its having an almost universal currency among coal-miners." Impressed with the above statement, and recognizing its importance to teachers of science especially, I call attention to it, under the head of 'Queries,' that hereafter truth shall be taught, and not error. I sometimes entertain a suspicion that many errors continue to be accepted as facts, because writers simply copy from their predecessors, instead of actually testing or proving them to be facts.

GEORGE GLENN WOOD, M.D.

Muncy, Penn., Oct. 28.